PROJECT facts

DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
FEDERAL ENERGY TECHNOLOGY CENTER

ADVANCED CLEAN/EFFICIENT
POWER systems

PS020.0497

CARBON DIOXIDE RECOVERY, REUSE, AND DISPOSAL

PRIMARY PROJECT PARTNERS

University of California (UCA)
Berkeley, CA

University of Michigan (UMI)
Ann Arbor, MI

University of Hawaii (UHA)
Honolulu, HI

Massachusetts Institute of Technology (MIT)
Cambridge, MA

Electric Power Research Institute (EPRI)
Palo Alto, CA

MAIN SITES

Berkeley, CA

Ann Arbor, MI

Cambridge, MA

TOTAL ESTIMATED COST

$

COST SHARING

DOE	**$—**
Non-DOE	**$—**

Project Description

Many scientists have concluded from historical meteorological data that the continuing buildup of greenhouse gases in the atmosphere is a threat to future climate stability. Results from some preliminary modeling studies have indicated that global temperatures could rise by 2 to 5 degrees C over the next half century, causing polar ice to melt, oceans to warm up, ocean levels to rise, and vegetation and crops to be critically stressed. In worst-case scenarios, mitigation of foreseeable natural disasters could be extremely expensive.

The Department of Energy's Office of Fossil Energy has initiated a number of projects to ultimately reduce greenhouse gas buildup in the atmosphere. The preferred option is to decrease greenhouse gas emissions at the source. A number of such projects are being pursued which will improve power plant efficiencies and thereby effectively reduce the production and release of carbon dioxide (CO_2). In the event that these efforts should prove to be inadequate and further reductions are required, other projects, which are described here, are aimed at directly removing CO_2 from the flue gas of coal-fired power plants and either reusing it or permanently sequestering the waste CO_2.

Preliminary studies have shown that some easy and obvious solutions, such as sequestering CO_2 in abandoned oil and natural gas reservoirs, would be largely ineffective. Five projects deal with various aspects of the CO_2/Greenhouse Gas problem. The project at the University of California analyzes the technical and economic feasibility of direct capture of CO_2 by microalgae production and subsequent conversion to substitute fuels. This technology would recycle CO_2 and reduce its buildup in the atmosphere. The project at the University of Michigan is a fundamental investigation of enhancement of algal growth by stimulation with high intensity artificial light in photobioreactors (PBR). The economics of bio-recycle of CO_2 depends chiefly on the maximum rates of growth that can be achieved. The optimal use of PBRs requires a full understanding of the mechanisms and interactions of photosynthesis and other physical and chemical processes taking place in controlled bio-systems.

The other three projects evaluate the feasibility of long-term storage of CO_2 (for centuries and millennia) in the ocean and in deep saline aquifers. The project at the University of Hawaii studies the chemistry of CO_2 injected into seawater, to determine conditions that favor the production of stable compounds, such as clathrates, which will trap and sequester the CO_2 permanently. The project at MIT researches the environmental impacts of ocean disposal of CO_2. The aim is to identify any potential environmental hazards of large-scale injection of CO_2 into the ocean, and to propose protocols for environmental monitoring. A more recent initiative is investigation of the feasibility of underground disposal of CO_2, as in saline aquifers. Hazardous and non-hazardous liquid wastes have been disposed of by underground injection into aquifers for many years. The physical and chemical behavior of CO_2 when injected into these deep aquifers will be analyzed to evaluate technical and economic feasibility and environmental safety. The work will be sponsored jointly by EPRI and DOE, with collaboration with Industry. Contractors have not yet been selected for this part of the program.

Carbon Dioxide Recovery, Reuse, and Disposal

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Program Goal

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Program Benefits

Recent international conferences in Montreal, Rio de Janeiro, and elsewhere, on greenhouse gas buildup and possible global climate change have pointed up the wide-spread concern among scientists and statesmen about this issue. Although the danger has not yet been fully defined, it is clear that time and resources for meeting the threat will be severely strained if the reality of global warming is suddenly confirmed. These projects aim at identifying and evaluating necessary and practical options which can be used by the President if quick action is required in the future.

The President, aligning with international consensus, has already taken steps to initiate preventative measures for reducing the release of CO_2 into the atmosphere with his Climate Change Action Plan. This Plan urges voluntary action by industry to reduce CO_2 emissions from various sources. Further steps, as deemed necessary, will be reuse (or recycle) of CO_2, followed by capture and sequestration of possibly massive amounts of CO_2. The projects in this Flue Gas Cleanup program will provide government officials with good information and practical options, without which wise decisions would be impossible, or at best very tenuous.

One facet of this search for practical options is that each option that proves to be impractical puts more urgency on the search among the other possibilities. For example, considering sequestration, disposal of CO_2 in abandoned oil and natural gas reservoirs seemed, at first, like a good option that could be used in an emergency. However, study has shown that long, expensive pipelines would be required to transport the CO_2 from the sources of CO_2 to the reservoirs. If the proposed study of aquifer disposal should show that this option also has only limited applicability, then finding means to make ocean disposal a workable solution becomes extremely important. Without practical disposal options to fall back on in an emergency course of action, and having to rely entirely on regulating CO_2 production, the global community could be very hard pressed to reduce CO_2 emissions.

The projects in this program will provide what could be crucial information necessary for dealing with future issues in this area. The topics covered represent a balanced program to identify practical ways to handle any problems that might come up, possibly in the not-too-distant future.

Cost Profile

(Dollars in Thousands)

	Prior Investment	FY95	FY96	FY97	Future Funds
Department of Energy*	$—	—	—	—	—
Private Sector Partners	$—	—	—	—	—

* Appropriated Funding

Key Milestones

FY94	FY95	FY96	FY97	FY98